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ABSTRACT

A review of representative instructional strategies and programs which focus on Science-Technology-Society (STS) themes is presented in this digest. A rationale and specific recommendations for the inclusion of an STS component in the science curriculum are offered. The options which exist for instruction of STS themes are identified and examples of each are stated. These include: (1) instructional approaches (highlighting the infusion, activity, and topic organizer approach); (2) units of study-modules (citing programs which consist of single modules, series of units, case study formats, and dilemma situations); (3) international programs (focusing on the offering of the United Kingdom and South East Asia). Selected publications related to STS topics are also identified. (ML)

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Science-Technology-Society in the Science Curriculum

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Introduction

Among the current goals for science education that are considered crucial for individuals and society are those that center on the interplay of science and technology and their interfaces with society. A science/technology curriculum built around societal issues has been offered as the pivotal point for school science in the 80's (Yager, 1984a). Trends toward viewing science as a discipline concerned with the study of the interaction and impact of science on society are apparent (NSTA, 1978). The dominance of technology in society today reaffirms these philosophical orientations and necessitates that today's students achieve a level of scientific/technological literacy that will help them deal with science-related societal issues for the improvement of their own lives and the advancement of society.

Specific recommendations have been formulated for instruction related to Science-Technology-Society (S/T/S). The National Science Foundation in 1982 recommended that a third year elective course in S/T/S be offered for 11 and 12 grade students. The National Science Board in 1983 suggested that a two-year required S/T/S sequence for grades 9 and 10 and a science curriculum in grades 9-11 be structured around the interactions of science and technology. Junior high students' need for familiarity in integrating technology with experiences in the sciences was addressed in the Final Report of 1983 of the National Science Board Commission on Pre-College Education in Math, Science, and Technology. Academic recognition and verbal support have been generous but cases of actual implementation reflect a different situation (Yager, 1984a).

A review of the literature provides support for the findings of the major science education studies of the 80's that S/T/S concepts are minimally incorporated in currently available textbooks and curricular programs. However, as theoretical recognition of the need for emphasis on S/T/S in the curriculum has grown, recent increases in programming efforts are being evidenced. This digest presents a sampling of representative approaches, modules, courses and programs that reflect a S/T/S theme.

Approaches

Time constraints in scheduling and limitations in teacher background information have been identified as deterrents in adoption of full scale S/T/S programs. If societal and technological concerns are to be included in the educational program, this must happen within currently operative syllabi. One infusion approach that has been tested at the junior and senior high school levels is the use of the provocative question or use of an imagination-provoking allusion (Brinckerhoff, 1985). These brief, open-ended questions and statements require little class time and minimal teacher training, and can be appropriately related to topics in conventional science courses. Student response has been reported as highly positive, with many students extending discussion and investigation after the allotted class time. A complete copy of the developed items is available for teachers and further field testing is encouraged.

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An activity approach exists as another option for interjecting technology and society concerns into science classes. Materials for incorporating this strategy range from state-developed curricula to suggestions for topics to be used as theme organizers. On the state level, the Pennsylvania Department of Education has identified 18 student competencies related to technology and provides suggestions and activities for each of the competencies (1979).

The S/T/S focus group of Project Synthesis has identified major topic areas that could help bring about the recommended desired state of literacy. These areas included the themes of energy, population, human engineering, environmental quality, utilization of natural resources, national defense and space, sociology of science, and effects of technological development. Comparable lists of topics have been offered as organizers for discussions, projects, and guided instruction.

Units of Study — Modules

Units of study and/or modules on S/T/S topics are available for a more specified and concentrated instructional offering. This option operates through an identification of a significant science-based societal issue and includes the learners' interests and concerns. Programs exist that are either individual modules or a series of modules. Representative programs of each type are reviewed below.

A regionalized single program module, the California Earthquake Education Project (CALEEP), was developed to increase understanding of earthquakes and their impact and to provide guidance in personal emergency preparedness (Thier, 1985). This module includes a variety of school and non-school-based activities which involves an array of inquiry-oriented processes, problem-solving situations and opportunities to use social skills. Experiments, surveys, role-playing and group discussions are some of the processes used to address the one hundred concepts and facts contained in this module. Observational and anectdotal evidence from early classroom trials of the materials indicate high student interest and involvement. Adaptations of this approach could be employed in instruction of other site-related hazards. Units focusing on such environmental problems as hurricanes, tornadoes or floods were recommended.

In addition to single module approaches, programs exist that are comprised of a series of units. Four representative programs are presented here. "Innovations: The Social Consequences of Science and Technology" consists of nine resource units developed by the Biological Science Curriculum Study for 11th and 12th grade and junior college level students (Tolman, 1981). Units are provided in the topic areas of science, technology and society; television; low-head hydropower; day care; energy technology; human reproduction; computers and privacy; biomedical technology; and food technology. These modules may be used in existing science or social studies courses or may form the basis of an interdisciplinary course of science, society and technology.

The "Contemporary Issues in Science" Program offers a case study approach for secondary level students to ex-

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amine 11 S/T/S related concerns (Staten Island Continuum of Education, 1982). A narrative and discussion question guide are presented for the issues of acid rain, radioactive wastes, hazardous wastes, Love Canal, aquifers, cloning, recombinant DNA, organ transplants, laetrile, genetic counseling, and birth control.

Comparable to the case study format, a dilemma discussion strategy is employed in the modules of the "Preparation for Tomorrow's World" Program (Iozzi, 1982). Dilemmas are brief stories in which conflicting moral/ethical issues are addressed. Guidelines for conducting the dilemma discussions, identification of the moral issues involved in each case and teaching strategies are offered for each of the 12 units. A sampling of the modules includes bioethics, environmental change, technology and changing life style, and future scenarios in communication.

Although most S/T/S materials focus on junior and senior high school students, programs at the middle school level are also available. One example is "Connections: A Curriculum in Applied Technology for the Fifth and Sixth Grades" (Melcher, 1982). The program consists of 10 lessons that consider such topics as recycling, solar energy, transportation and nutrition. Each lesson includes teacher background information, class activities, homework, discussion topics, and a brief quiz.

Science teachers and science educators collaborated to produce "Science, Technology, and Society, Block J" for the New York State Education Department (1985). This block has been designed for use in middle/junior high school science classes. It is to be infused into instructional programs already in place in the areas of life, physical and earth science. Through participation in the S/T/S activities in Block J, students are expected to understand what science and technology are, and how they interact with one another and with society, and to use this understanding to solve problems and make decisions at home, in school, in the neighborhood, and in the community. Topics range from how is a thermometer made?, what is in an aerosol spray? to who owns the sun? and what can we do about world hunger?

International Programs

The S/T/S movement has witnessed a growth in international programs. In the United Kingdom two national projects have been widely received and implemented. Twelve modules comprise the "Science in Society" program. Topics discussed in this project include: diseases, medicine, population and health, food, agriculture, energy, mineral resources, industry, nature of science, science and social development, and future. The second U.K. project is entitled "SISCON" (Science in a Social Context). This program addresses contemporary issues as evolution, the atomic bomb, health and space cosmology (Yager, 1984b).

An approach to link abstract and theoretical concepts to technology and to societal issues was developed by South East Asian teachers who participated in a course entitled "Innovative Approaches to Biology Teaching" (Kam, 1985). The team focused on the topic of microbiology to demonstrate the relevance of biotechnology in society today. The course consists of five units of practical enquiry-based activities. Exposure to this topic and approach was intended to create an awareness in both teachers and students of new fields and applications of technology for the developing countries of South East Asia.

Conclusions

Assessment findings indicate that students continue to show low levels of knowledge about S/T/S related problems and negative perceptions of themselves as change agents for socio-scientific conditions (Thier, 1985). To assist youth in becoming responsible citizens with the knowledge and decision-making skills critically needed to meet the challenges of a high-tech setting, S/T/S issues must be included in present day curricula.

Several options exist for instruction of S/T/S themes. Infusion within established programs, integration between disciplines and establishment of complete courses have been occurring with significant levels of success. Possibilities exist for teachers to select programs that would be most appropriate in individual settings.

Teachers need to be informed of trends and developments in this area. Recently there has been a proliferation of S/T/S related publications. In the past decade, at least 91 journals and newsletters have emerged, of which 62 originate in the U.S., 20 in the U.K. and 9 in Canada (de la Mathe, 1983). Journals such as the Science, Technology and Society Curriculum Newsletter of Lehigh University (Cutcliffe, 1985), and the S-STS Reporter (Roy, 1985) are representative of the serials that provide information, insights and suggestions for classroom instruction.

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